inhabitants of the Tanganika shores and the artistic people of Manyema, with their elaborately coiffeured heads. To speak of these people, and even many of the tribes on the banks of the Livingstone, as savages is a misuse of language. People who can build houses and organize villages and towns such as they do, who can work their native iron, ivory, wood, and bone, into all sorts of artistic and useful shapes, and who can reason and speak as Mr. Stanley shows us they do, have raised themselves to a level considerably higher than the savage. West of Tanganika, especially, the tribes seem very much mixed up, and there are many evidences that the Livingstone with the neighbouring region is a sort of borderland where several races meet, and where a constant struggle is going on. What can be made of these Africans under competent direction, Mr. Stanley himself has shown us in the case of his own people.

Of the various products, mineral, vegetable, and animal, of the country through which Mr. Stanley passed we have many glimpses. The natural wealth of the country is extravagant, and the botanist especially will find much that will interest him, especially as Mr. Stanley has been at the trouble of frequently giving the scientific names of the plants which he mentions.

There is ample furniture of maps in the work, all of them well-executed, though in Mr. Waller's two large maps there are occasional signs of carelessness in the spelling of names, and, very strangely, the memorable Vacovia of Sir Samuel Baker is omitted from the names on the east shore of Albert Nyanza. Beside the two large maps of East and West Equatorial Africa, by Mr. Waller, there are also an interesting series of five maps by the same hand, showing the progress of discovery in Equatorial Africa. There is, first, a portion of Dapper's map of 1676, very similar to that of 1701, which we gave last week, showing two great central lakes, from the most westerly of which, Zaire lacus, issue both the Nile and Congo. The next one shows our knowledge between 1849-56, with all the features of Dapper's maps swept away, and the first rude indication of Tanganika given. Then, between 1856-63, we have the work of Livingstone, Burton, Speke, Grant, enabling us to more correctly define Tanganika, locate Victoria Nyanza, and shadow out Albert Nyanza. The next stage, 1866-75, shows a great advance. By the labours of Schweinfurth, Baker, Livingstone, Stanley (first journey), and Cameron, the main features, from 10° N. to 15° S., east of 25° E. long. —rivers, lakes, and mountains—are filled in more or less accurately. Last of all come the results of the journey described in these two volumes, and which we have endeavoured to summarise in this notice. There is also a chart of the Lukuga creek, and two beautiful large-scale charts, by Stanford, of the Livingstone or lower falls (thirty-two in number), and of the upper or Stanley falls. Mr. Cooper has, as usual, done his part well in reproducing the numerous and varied illustrations; and altogether the get-up is thoroughly creditable to the publisher.

In conclusion, let us repeat that Mr. Stanley has done a great work, and told us all about it in a great book.

## OUR ASTRONOMICAL COLUMN

THE TRANSIT OF MERCURY, 1868, NOVEMBER 4.—The second internal contact at this transit was well observed in many European observatories, though at others the bad definition and tremulousness of the sun's limb vitiated the results. If we calculate strictly from Leverrier's tables of sun and planet, with Prof. Newcomb's value of the mean solar parallax, 8″·848, we shall have the following formula for reduction of the observed Greenwich mean time at any place to the centre of the earth :—

$t = 20h.\ 59m.\ 51^{s}\cdot9s. + [1\cdot4056]\, r\sin l - [1\cdot7832]\, r\cos l, \cos(L + 55^{\circ}\ 51'\cdot5)$,

where $l$ is the geocentric latitude, $r$ the radius of earth at the place, and $L$ the east longitude from Greenwich.

A comparison with observations shows differences as below :—

| Place of Observation. | Observed G.M.T. reduced to earth's centre. h. m. s. | Error of the Calculation. s. | |
|---|---|---|---|
| Bonn | 21 0 3·4 | − 11·5 | Three observers: extremes differ, 13·5s. |
| Christiania | — 6·3 | − 14·4 | Four observers |
| Durham | — 12·2 | − 20·3 | |
| Greenwich | — 6·9 | − 15·0 | Six observers. |
| Leyton | — 12·6 | − 20·7 | |
| Lund | — 14·4 | − 22·5 | |
| Madrid | — 13·8 | − 21·9 | Merino. Rupture of ring. |
| Marseilles | 20 59 57·6 | − 5·7 | Leverrier. |
| ,, | 21 0 12·6 | − 20·7 | Stephan. |
| Paris | — 7·6 | − 15·7 | Mean of André, Villarceau, and Wolff. |
| ,, | 20 59 57·0 | − 5·1 | Rayet. |
| Rome | 21 0 10·4 | − 18·5 | Secchi and Mancini. |
| Vienna | 20 59 55·5 | − 3·6 | Oppolzer. |

At the Royal Observatory, Cape of Good Hope, where the transit was very completely observed, the sun's limb is stated to have been tremulous at the second internal contact, which probably accounts for the larger difference, −32·2s., between calculation and observation.

BRORSEN'S COMET OF SHORT PERIOD.—When the elements of this comet, at its first appearance in 1846, had been satisfactorily determined, it was pointed out by Mr. Hind, in a communication to the Royal Astronomical Society, that the comet must have made a very close approach to the planet Jupiter about May 20, 1842, and that probably to this near approximation the form of the orbit in 1846 might be attributed. The late Prof. D'Arrest examined this question more closely in the year 1857, and by the formulæ of the *Mécanique Céleste*, which had been already applied in the case of Lexell's comet of 1770, he ascertained that a great change of elements was then caused by the action of Jupiter, assuming the mean motion given by the observations of 1846 to be affected with no material error, as we now know to have been the case. He found that the greatest proximity occurred May 20·69, Berlin time, when the distance of the comet from Jupiter was only 0·0511 of the earth's mean distance from the sun, and that previous to April 19, 1842, the elements of the comet's orbit were as follows. The elements of 1846 are added for comparison :—

| | Elements before the great perturbation. | | Elements in 1846. |
|---|---|---|---|
| | ° ′ | | ° ′ |
| Mean longitude, 1842, April 19·5... | 237 16 | ... | — |
| Longitude of perihelion ... ... | 133 27 | ... | 116 28 |
| ,, ascending node ... | 107 44 | ... | 102 40 |
| Inclination to ecliptic ... ... ... | 40 51 | ... | 30 57 |
| Eccentricity ... ... ... ... ... | 0·59275 | ... | 0·793863 |
| Semi-axis major ... ... ... ... | 3·68645 | ... | 3·15352 |

These figures prior to 1842 are necessarily only a first approximation to the orbit then described, but they sufficiently explain the circumstance of the comet not having been observed before that year, since the perihelion distance was then greater than 1·5, and as Prof. D'Arrest remarked, under this condition Brorsen's comet would hardly be observable.

According to Dr. Schulz's elements for 1873, when the comet was last visible, the nearest approach of its orbit to that of Jupiter now takes place in 283° 30′, when the distance is 0·124, and thirteen revolutions of the comet are almost exactly equal to six revolutions of Jupiter. D'Arrest, from a rough calculation, considered that the orbit might again undergo great or complete change from the action of this planet in the year 1937. The only

other planet which the comet can approach with its actual elements is Venus, which, near the ascending node, may be within 0·11.

MIRA CETI.—According to Schönfeld's calculation the next *minimum* of this variable will occur on June 23. and the next *maximum* on October 11. There are comparatively few observations of the former phase and more attention to it is desirable. At present it is assumed that the perturbations of the maximum deduced from Argelander's formula, apply also to the nearest minimum. In this case the sum of the perturbations is +29·9 days.

## GEOGRAPHICAL NOTES

WE last week referred to the important work done by Sir Andrew Scott Waugh in connection with the Great Trigonometrical Survey of India, and from the recently issued Report of Colonel Walker, the present Superintendent of the Survey, it will be seen that the work is being carried on with unabated energy. The Report refers to 1876-77, and tells us that during that year an area of 5,019 square miles was covered by principal triangulation; under secondary triangulation 5,400 square miles have been covered with points for the topographical survey, 3,100 miles have been operated in *pari passu* with the principal triangulation, and in an area of 23,600 square miles, lying mostly in portions of the Himalayas which are inaccessible to Europeans, a number of points have been fixed which will be valuable for geographical rectifications. The topography of upwards of 5,000 square miles has been completed in scales varying from half an inch to two inches, while several important geodetic operations were accomplished. In these Reports there is generally some important geographical work to record, accomplished by one of the native officials of the Survey. During the year 1876, the Mullah, one of the Survey explorers, made a survey up the course of the Indus from the point where it enters the plains above Attok, to the point where it is joined by the river of Gilghit. This is the only portion of the Indus which had remained unexplored. Here the river traverses a distance of some 220 miles, descending from a height of about 5,000 feet to that of 1,200 feet above sea-level. Its way winds tortuously through great mountain ranges, whose peaks are rarely less than 15,000 feet in height, and culminate in the Nanga Parbat, the well-known mountain, whose height, 26,620 feet, is only exceeded by a very few of the great peaks of the Himalayas. The river in many places is hemmed in so closely by these great ranges that its valley is but a deep-cut, narrow gorge, and, as a rule, there is more of open space and culturable land in the lateral valleys, nestling between the spurs of the surrounding ranges, than in the principal valley itself. No European has ever penetrated this region, and the Mullah only managed it by travelling as a privileged trader. Very difficult of access from all quarters, it is inhabited by a number of hill tribes, independent and suspicious of each other, and protected from each other by natural barriers and fastnesses. Each community elects its own rulers, and has little intercourse with its neighbours, and with the outer world only by means of privileged traders.

THE captain of a German steamer, just arrived at Hongkong, reports a singular condition of things in the island of New Britain, in the South Seas. He found the whole of the north-east coast enveloped in dense smoke, and he experienced great difficulty in proceeding up the channel between it and New Ireland, as fields of pumice-stone, several feet in thickness, covered the surface of the water. On February 9 he reached Makada, Duke of York group, and found that three craters had broken out in the New Britain peninsula, at the foot of the so-called Mother and Daughters Mountains, from which dense masses of pumice-stone were continually being thrown up. The passage between Duke of York Island and Blanche Bay had been completely closed by a compact field of pumice-stone, about five feet in thickness, according to the statement of the captain to a Hongkong paper. A tidal wave swept over Blanche Bay on February 10, and soon afterwards a new island appeared, about three-quarters of a mile in diameter. This island is situated to the south of Natopi, or Henderson Island, and where it now is no bottom was previously obtained at seventeen fathoms. It is probable that other alterations have taken place which could not be observed at the time, owing to the masses of floating pumice-stone. The captain of the vessel mentioned further states that the water in Blanche Bay was scalding hot for two days, and that immense quantities of boiled fish and turtle were thrown on shore, and eagerly devoured by the natives, who were starving in consequence of the unusual dryness of the season.

THE party which left England last month for Egypt on their way to reinforce the Church Missionary Society's expedition to the Victoria Nyanza, will proceed by steamer to Suakim, the port of Southern Egypt, accompanied probably by a dragoman engaged by the British Consulate at Cairo. At Suakim it is proposed that they shall engage camels to transport them across the desert to Berber, on the Nile, whence they will travel by steamer to Khartum. From that point they will journey under Col. Gordon's protection, and will, doubtless, have no difficulty in reaching Gondokoro. Thence it is arranged that they shall proceed by the Egyptian military outposts to the frontiers of Uganda, in which country Col. Gordon now has an agent, whose presence will no doubt insure safety to Europeans.

A LETTER from the French Ogowé Expedition was read at the last meeting of the Geographical Society of Paris. It is quite a year since it was written, and some apprehensions have been entertained as to the safety of the explorers. M. de Brazza states that the Ogowé is reduced to small proportions and flows from the south, so that it gives the impression of being really an arm detached from the Congo. The expedition was to travel northwards in order to examine the sources of a powerful affluent. Illness was prevailing amongst the small party, and the hostility of the native tribes was growing stronger.

THE forthcoming congress of the Geographical Society of Paris will not be international, but national, although it will be open to foreigners. The principal aim of the congress will be to organise a federation, between the Paris Society and similar institutions which its influence has started in large provincial cities during the past five years—viz., Lyons, Bordeaux, Marseilles, and Montpelier, where a society for the whole of Languedoc was recently established.

A REUTER'S telegram states that the schooner *Eothen* will probably sail from New York on Monday next for the Arctic regions to search for relics of the Franklin expedition. No doubt the purpose of this expedition is to obtain the relics reported to be in the possession of some of the mainland Eskimo.

A MEETING of the subscribers to the African Exploration Fund of the Royal Geographical Society will be held in the theatre of London University at 3 P.M. on Friday, June 14. Sir Rutherford Alcock, K.C.B., Chairman of the Committee, will preside.

## ON A NEW METHOD FOR DISCOVERING AND MEASURING ÆOLOTROPY OF ELECTRIC RESISTANCE PRODUCED BY ÆOLOTROPIC STRESS IN A SOLID[1]

TORSION of a metal tube within its limits of elasticity produces æolotropic stress, of which the mutually perpendicular lines of maximum extension and maximum

[1] Abstract of a Paper read by Sir W. Thomson at the Physical Society, May 25.